

Brad Botwin
Director, Industrial Base Studies
Bureau of Industry and Security
U.S. Department of Commerce
Washington, DC 20230

Dear Mr. Botwin:

Pursuant to your request for public comment on the *Risks in the Semiconductor Manufacturing and Advanced Packaging Supply Chain* (Docket No. 210310-0052), I am submitting these comments on behalf of Calumet Electronics Corporation.

Risks to Microelectronics

In partnership with defense and commercial OEMS we have identified certain risks to the United States microelectronics manufacturing ecosystem. Although from our position within the industry we can only provide anecdotal observations and evidence, we recommend these risks be fully investigated by IBAS.

The identified risks are as follows:

1. **The domestic electronics industrial base does not have capability or capacity to produce IC substrates used in advanced microelectronics packaging, rather the United States is totally dependent on Asia.** The substrates are typically referenced as *organic substrates*, *interposers*, and *High-Density Build-Up (HDBU) substrates* and are typically sourced from offshore manufacturers such as Kyocera, Japan.
2. **The domestic electronics industrial base has negligible capability or capacity to produce the very complex High-Density Interconnect (HDI) printed circuit boards (PCBs) used with microelectronics advanced packaging.** Although the U.S. market is improving for conventional PCBs, there is a distinct lack of capability and capacity when circuit traces and spaces drop significantly below 75 microns.
3. **The domestic electronics industrial base is lacking *additive process* capability to produce ultra-fine copper circuits on HDBU Substrates or HDI PCBs of 6 to 50 microns that are necessary to compete with Asia.** Most of the U.S. industrial base is limited to 75+ micron traces using traditional subtractive processes. The U.S. must stand up additive processes to produce 6- to 50-micron traces and spaces or be left behind.
4. **The domestic electronics industrial based must find a replacement material for Ajinomoto Build-Up film used in many Programs of Record.** The U.S. is heavily reliant on Ajinomoto company, Japan, to source this unique build-up film used in HDBU Substrates and soon in Substrate-Like PCBs (SLP). The U.S. is low priority for demand fulfillment and end-use restrictions may disqualify the use in DoD applications, leaving the DoD without a source of materials for Programs of Record.

The root cause of these risks is well understood by IBAS, who in early 2018 characterized the U.S. PCB manufacturing industrial base as “dying on the vine”. Unfortunately, the fifteen-year decline of the industrial base has resulted in a lack of capability that gives Asia a competitive advantage in electronics manufacturing technologies, but more dire, the U.S. is now experiencing uncertain and uncontrolled supply chains with lead times of 50+ weeks according to defense OEMs.

Defense OEM of interest:

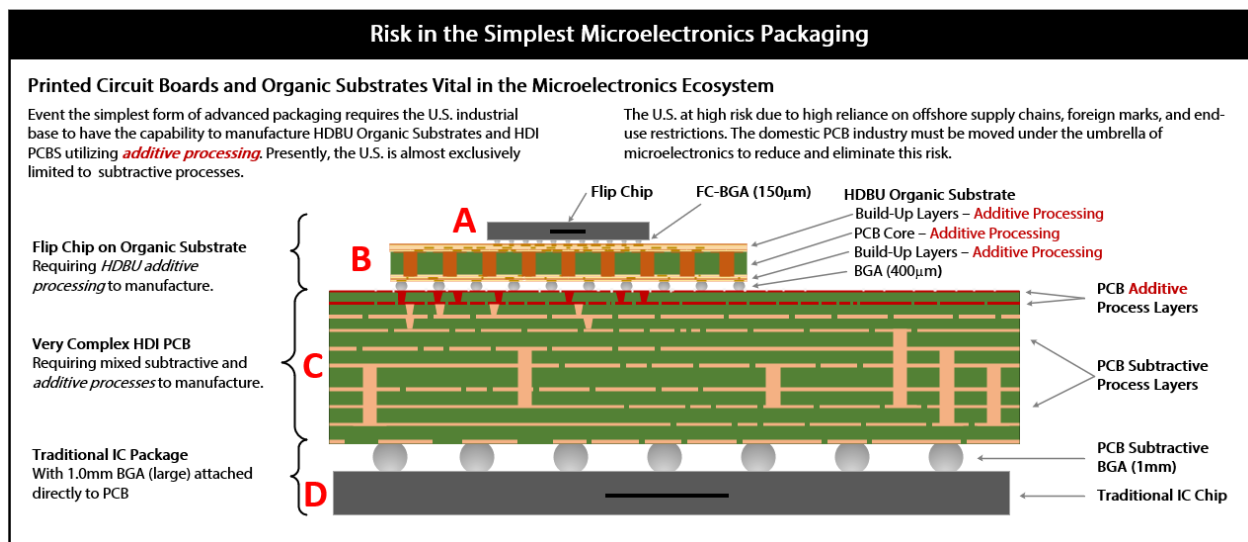
“... has seen an increase in supply chain risk within the HDBU market with lead times increasing up to 200% for critical material to support our Programs of Record due to our suppliers in Asia pivoting to prioritizing the commercial over the defense industry.”

Commercial OEM of interest:

“The domestic supply of High-Density Interconnect (HDI) PCBs and next-generation High-Density Build-Up (HDBU) substrates for use in advanced RF packages is lacking. The majority of HDI boards and essentially all the HDBU substrates are made overseas in Asia (predominantly Taiwan, Korea, Japan, and China). This is of special concern to our company as we look to set up the domestic supply chains to feed our recently created Navy-sponsored SOTA Heterogenous Integration Packaging (SHIP) Centers for the design, assembly, and test of RF multi-chip packages (MCPs). The current maturity and capabilities of domestic HDI laminate suppliers lag those of their offshore counterparts. The range of available HDI low-loss material sets and scaled design rules (e.g. line/space, via capture pads, etc.) is more limited. In the case of HDBU substrates, for use as advanced organic interposers, the situation is more dire with no viable suppliers to compete with what is available from the Asia based suppliers.”

The Problem

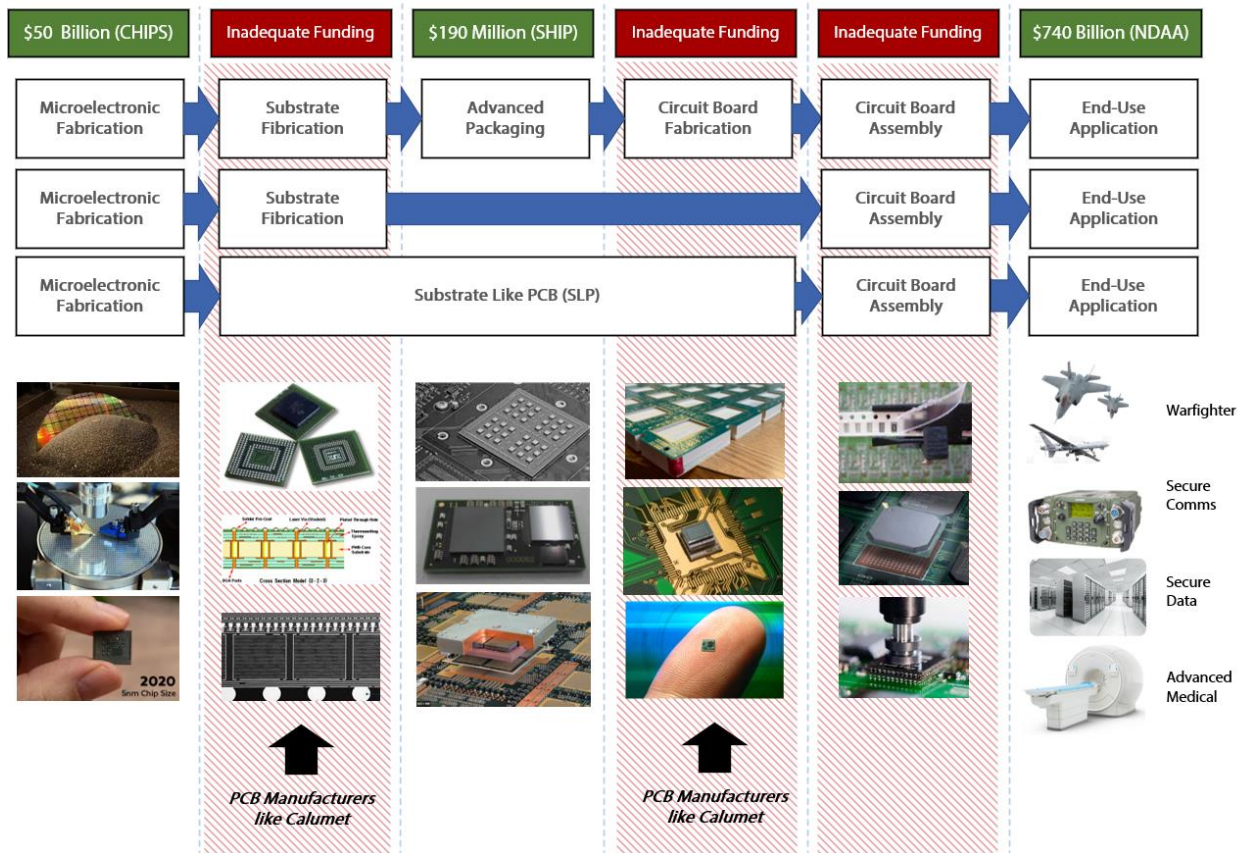
The following figure illustrates the interconnection of a single IC to a PCB. The components shown are [A] the flip chip, [B] HDBU Organic Substrate, and [C] Very Complex HDI PCB. Also shown is [D] a larger traditional IC package to compare size and density.



The United States aggressively protects its leadership position with the design and manufacture of semiconductors and microelectronics [A] while paying little to no attention to HDBU Organic Substrates [B] and regarding all printed circuit boards [C] as a commodity. This situation indicates a lack of awareness, good sense, or judgment by the U.S. government and Department of Defense. Excluding PCBs and IC substrates from the microelectronics ecosystem represents a grave risk to the United States.

PCB manufacturers like Calumet, are working to rapidly close the gap between the United States and Asia, but we are constantly up against an utter lack of acknowledgement, support, and funding from the federal government or Department of Defense to mature manufacturing capability. Policy makers must bring PCB manufacturers under the umbrella of microelectronics and its associated programs to protect the electronics industrial base.

Where do Printed Circuit Boards & IC Substrates fit in the microelectronics supply chain?



Recommendation

The products produced by PCB manufactures must be designated as vital to the microelectronics ecosystem as necessary components for semiconductors and advance packaging. Policy makers must afford incentives, support, and protection of that portion of the U.S. electronics industrial base that produces HDI PCBs and HDBU substrates to close the gap between U.S and Asian manufacturing capability. Small Businesses like Calumet can make all the difference in the war for technological superiority, but the effort will take too long or potentially fail without some level of support from the federal government or the DoD.

Calumet as an Example of Standing Up IC Substrate Production Capacity

Calumet Electronics Corporation is an award-winning engineering and manufacturing company that fuels industrial collaboration to advance production of next-generation electronics in the United States. Calumet is recognized for industry thought leadership and the advancement and commercialization of circuit board and microelectronics substrate manufacturing processes necessary for domestically sourced electronics.

Calumet is 100% American owned and operated with zero offshoring. Calumet is America's only HUBZone certified PCB supplier. Incorporated in 1968, Calumet is historically a high-volume manufacturer of PCBs, shipping over 4 million circuit boards annually from its 160,000 sq. ft. facility located in the remote Upper Peninsula of Michigan. Calumet is innovating to close the gap between U.S. and Asian capability.

Central to Calumet's business strategy is domestic production capability and capacity for sequential build-up (SBU) substrates with multiple core-types (organic, glass), Ajinomoto Build-up Film (ABF), and substitute build-up films in strategic cooperation with domestic materials manufacturers. Demand for these manufactured substrates sourced from the United States has crystalized and is urgent for OEMs and DoD agencies. This presents an opportunity for Calumet to leverage its industrialization of Averatek A-SAP™ science to solve domestic substrate sourcing problems for defense and commercial markets.

Calumet's road map clearly defines the capital requirements, timeframes, and anticipated capability and output capacity. Calumet typically self-funds from operational profits for enhancements of capability and capacity. However, OEMs and DoD agencies are pressing Calumet to move faster due to factors such as uncertainty of Asian supply chains, imposed end-use restrictions, deprioritization by Asian manufacturers due to U.S. low volume requirements, and slow erosion of inventory. These end-users have stated prototype and low volume needs between 2021-Q4 and 2022-Q3, sooner if possible.

Calumet is seeking partners to accelerate progress and reduce the commercialization timeframe through prototype builds, low volume production runs, qualification testing, and funding opportunities for advancing MRL and procuring equipment. Calumet is presently seeking funding through AFWERX SBIR, ManTech, Title 3, DoD program funding, and long-term strategic agreements. Calumet is pursuing all opportunities to build-up the necessary machine set to increase capability more quickly. Regardless of the funding outcome, Calumet is committed to being a safe, secure, and sustainable domestic manufacturer of SBU substrates.

More Information

Thank you, the opportunity, to comment on the *Risks in the Semiconductor Manufacturing and Advanced Packaging Supply Chain*. This document was composed rapidly, please forgive its lack of polish. We encourage representatives from IBAS to reach out and discuss these topics further with us. We offer unique and relevant comments from the perspective of a small domestic business at the forefront of solving problems with microelectronics problems for U.S. OEMs. Please contact me at any time, thank you.

Sincerely,

A handwritten signature in black ink, appearing to read "Todd Brassard".

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